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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
MOONAN, FRANCIS P	

ART UNIT	PAPER NUMBER
1638	12

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/576,623	CARMAN, JOHN G.	
	Examiner	Art Unit	
	Francis P Moonan	1638	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17January 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-34* is/are pending in the application.

4a) Of the above claim(s) *10,13-15,19-22 and 24-33* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9,11,12,16-18,23 and 34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 May 2000* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 10.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

In Paper No. 10 filed on 17 January 2002, applicant requested amendment to Claims 1, 17, 18, and that Claim 34 be newly added.

The request for amendment to the claims and that claim 34 be newly added is acknowledged, and the amendments and newly added Claim 34 have been entered.

Claims 10, 13-15, 19-22, 24-33 are withdrawn from consideration as drawn to a nonelected Group.

Applicant is advised that the Declaration of Paper No. 4 filed on 15 February 2001 has been considered.

Claims 1-9,11-12, 16-18, 23, and 34 are examined in the Office Action that follows, and that Claims 18 and 23 will be examined to the extent that they are read on an Elected Group I.

Response to Traverse of the Restriction Requirement

Applicant's election with traverse of Group I, Claims 1-9, 11-12, 16-18, and 23, in Paper No. 10 filed on 17 January 2002 is acknowledged.

The traversal is on the grounds that: 1) the classification of Group II is incorrect (See page 11, lines 13-15; and page 11, line 21 to page 12, line 1, of the traverse of Paper No. 10); 2) that when an invention may be classified into the same class and subclass, that a requirement for restriction is not supported (See page 10, line17 to page 11, line 4, of the traverse of Paper No. 10); 3) that the examiner has not shown separate classification, separate status in the art, or a different field of search for the Groups, and that even if the classification is technically correct, that there would not be a burden of search placed on the examiner to search the other Groups (See page 12, lines 7-19 of the traverse of Paper No. 10); and that the classification of Group IV is incorrect.

Applicant's traverse is not found persuasive because:

The common dictionary-style interpretation of a mutation is "an inheritable alteration of the genes or chromosomes of an organism". Accordingly, the classification of the invention of Group II is not incorrect as asserted by applicant. Furthermore, classification is not the only grounds for restriction relied upon by the examiner.

Applicant's traverse that the restriction of Groups I and III was improper, directly contradicts applicant's admission on page 9, lines 1-6, of Paper No. 10. As discussed in Paper No. 9, Groups I and III are distinct because: the Groups I and III make chemically and structurally distinct products; the methods use structurally and chemically different starting materials; and the methods use different method steps to modify the different starting materials into different products; thus necessitating a different search for each group. Applicant's traverse that the examiner has not shown separate classification, separate status in the art, or a different field of search, or that there would be no "serious burden" or "serious extra burden" on the examiner to search and examine all of the Groups together, is not persuasive because the examiner has demonstrated separate classification, divergent subject matter, and burdensome search requirement as established in Paper No. 9.

Regarding the classification of Group IV, applicant traverses on page 11, lines 21-22 of paper No. 10, that in Paper No. 9, that Group IV was classified for example in "class, 298, subclass 269", drawn to a dumptruck. The examiner concedes that this classification is incorrect, but asserts that it was an obvious typographical error. The examiner thanks the applicant for pointing out said error. The classification should have read --class 800-- rather than "class 298" . Class 800, subclass 269, reads on a method of breeding involving interspecific crosses, and Group IV is a method of breeding with plants of a different ploidy, which certainly encompasses plants of different species. Independent of classification, the reasons for the distinctness of Group IV from the other Groups has been previously established in Paper No. 9.

The restriction requirement is still deemed proper and is therefore made FINAL.

Priority

The instant application of 09/576,623 filed on 23 May 2000 is a Continuation of Application No. 09/018,875, filed on 5 February 1998, which was abandoned on 4 December 2000. The Instant Application claims priority to Application No. 09/018,875, and to Provisional Application No. 60/037,211, filed on 5 February 1997.

Applicant has not complied with one or more conditions for receiving the benefit of an earlier filing date under 35 U.S.C. 119(e) as follows:

The second application must be an application for a patent for an invention which is also disclosed in the first application (the parent or provisional application); the disclosure of the invention in the parent application and in the second application must be sufficient to comply with the requirements of the first paragraph of 35 U.S.C. 112. See *Transco Products, Inc. v. Performance Contracting, Inc.*, 38 F.3d 551, 32 USPQ 2d 1077 (Fed. Cir. 1994).

The provisional application upon which priority is claimed fails to provide adequate support under 35 U.S.C. 112 for Claims 1-9, 11-12,16, and 16-18 of this application. Claims 1-9, 11-12,16, and 16-18 are methods which each have a critical and essential method step of identifying starting plant materials. In the instant invention, those starting plant materials are broadly recited and disclosed as: 1) identified on the basis of a comparative divergence in flowering responses to various photoperiods; 2) made with intraspecific or interspecific hybridization with a broadly recited "plant species" or broadly recited "group of plant species"; and 3) are not apomictic, but used to make an apomictic plant, by taking advantage of asynchronicity in gametophytic or nongametophytic plant biology that occurs as a result of the combining ability of the specific plant genomes used, and the environmental conditions used. The disclosure of Provisional Application No. 60/037,211 fails to disclose the step of the identification of starting materials by their different flowering responses, critical and essential to the making of the invention of the claims, since the biological basis and rationale for the methods as recited in the claims and disclosed in the instant specification are that apomictic plants are developed by combinations of genotypes that lead to asynchronous regulation or reproductive development.

Accordingly, applicant is denied priority to Provisional Application No. 60/037,211, and a priority date of 5 February 1997.

Drawing Objections

The drawings in this application are objected as informal. This application has been filed with informal drawings which are acceptable for examination purposes only.

Any drawing corrections requested, but not made in the prior application should be repeated in this application if such changes are still desired. If the drawings were changed and approved during the prosecution of the prior application, a petition may be filed under 37 CFR 1.182 requesting the transfer of such drawings, provided the parent application has been

abandoned. However, a copy of the drawings as originally filed must be included in the 37 CFR 1.60 application papers to indicate the original content.

Formal drawings will be required when the application is allowed.

Claim Objections

Claims 18 and 23 are objected to because of the following informalities:

Required ";" punctuation marks are missing from Claim 18 and are required to be inserted on line 24 after "plants" and prior to "and"; and also the conjugation --and-- should be inserted after "stages" on line 32.

Furthermore, Claim 18 is objected to, because the methods of "producing" by "somatic cell hybridization", or via "polyploid", "triploid", or "aneuploid" plant production recited in Claim 18 are each drawn to an invention of a nonelected Group.

Claim 23 is objected to, because the "polyploid", "triploid", or "aneuploid" methods recited in Claim 23 are each drawn to an invention of a nonelected Group.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-9,11-12,16-18, 23,and 34 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1, 17, and 18 are indefinite in the recitation of "related plant species". All flowering plants are evolutionarily related, so the phrase fails to set forth the metes and bounds of the invention.

Claim 1 is also vague and indefinite in the recitation of "obtaining at least two sets of delineated lines from a plant species...tissue;". The claim recites differentiated species, and different flowering responses, but does not delineate the recited "lines", and it is unclear as to

what criteria are actually utilized to delineate the "lines". The claim is also indefinite as to how many lines would be obtained to make the invention.

Claim 1 is also vague, confusing, and indefinite in the recitation of "(b) hybridizing..., and selecting hybrid lines that contain genetic material of each set of delineated lines such that asynchronous floral development, and therefore apomixis, is conferred". The recited phrase in the body of the claim is vague in that it only recites a selection step only for hybridity, without a clearly defined step of identification or selection for the trait of apomixis.

Furthermore, Claims 1 (b) and 17 (e) are confusing, because they describe as equivalent biological processes, both asynchronous floral development and apomixis, when they are clearly not equivalent biological processes. For example, asynchronous development may produce infertility, without apomixis.

Claims 1-4 and 17-18 are vague in the recitation of " flowering response" (Claims 2-3) and "flowering responses" (Claims 1, 4, 17, and 18). The phrase is vague because it is unclear as to whether the intended meaning would include initiation of flowering; or would include a response from an already formed flower; or whether the response includes such light responsive metabolic responses such as alterations in rates of photosynthesis and respiration associated with changes in photoperiods. For example, the recitation of a "flowering response(s)" is unclear as to what the metes and bounds of the physiological, morphological, or biochemical response(s) is(are), since all photosynthetic plant tissues exhibit a wide range of different biochemical, morphological, and physiological responses to light regimes, including alterations in rates of photosynthesis and respiration associated with changes in photoperiods.

Claims 5-6 and 18 are vague and confusing in the recitation of "early embryony", which is not a part of a natural female developmental stage. Polyembryony, for example of the nucellar type, although maternal in origin, is nongametophytic.

Claim 7 is vague and confusing in the recitation of "is obtained by plant breeding". The claim reads on either the differentiation or the method obtained by plant breeding. The method is not obtained by plant breeding, but may utilize plant breeding steps. The differentiation is not obtained by plant breeding, but by biological processes, but the differentiation may be selected for as a trait in a plant breeding step.

Clam 9 is vague and confusing in the recitation of "the genetic material comprises genomes from each set of delineated lines that confer appropriate degrees of asynchrony as measured by the expression of apomixis". The phrase " appropriate degree of asynchrony " renders the claim indefinite because the claim includes elements not actually disclosed (those encompassed by "the appropriate degree of"), thereby rendering the scope of the claim(s) unascertainable. See MPEP § 2173.05(d).

Claims 17-18 are rejected as generally narrative and indefinite, failing to conform with current U.S. practice. They appear to be narrative rather than descriptive, and are replete with grammatical and idiomatic English errors. Claims 17-18 are vague in the recitation of the phrase "(d)obtaining two sets of delineated lines" in step (d) of each of the claims. It is unclear as to how the delineated lines of step (d) relate to the plants identified in step (c); or whether they are completely different plants, and it is unclear as to how the "delineated" lines in step (d) may possibly relate to the series of hybrids recited in step (e) , in each of claims 17 and 18. Furthermore, Claims 17-18 are rejected because they each appear to be incomplete for omitting essential steps, such omission amounting to a gap between the steps. See MPEP § 2172.01. Applicant is advised that the omitted step in each of the claims appears to be one similar to that of step (c), but is instead a step between (d) and (e), as a step for the identifying within and between said sets of lines divergence in start times and duration of female developmental stages relative to development of nongametophytic ovule and ovary tissues.

Furthermore, Claims 17-18 are vague in the recitation of "divergence in start times and durations of female developmental stages relative to development of nongametophytic...tissues". The phrase is vague as to what are the metes and bounds of the cellular and tissue-specific developmental recited for by the claim language, since any particular nongametophytic plant tissue would certainly have a divergence in start time in some form of developmental process.

Furthermore, Claim 17 is vague, confusing, and indefinite in the recitation of "selecting hybrid lines". The claim is vague and confusing because the preamble of the claim recites "[A] method for obtaining apomictic plants from sexual plants comprising:", but the phrase of "selecting hybrid lines" fails to recite selection for any particular trait. Furthermore, the unspecified selection step recited in the claim renders the claim indefinite, as it may be drawn to

an indefinite multitude of selection steps for any anatomical, morphological, physiological, or biochemical trait characterized from any aspect of the hybrid's biology.

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-9, 11-12, 16-18, 23, and 34, are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 1-9, 11-12, and 16-18, 23, and 34, are broadly drawn to a method for obtaining apomictic plants from sexual plants comprising the steps of : obtaining two sets of delineated lines selected from a plant species or group of plant species differentiated on the basis of different flowering responses to various photoperiods and by their start times and durations of female developmental stages relative to nongametophytic ovule and ovary tissue; hybridizing said lines; and selecting apomictic lines from the interspecific or intraspecific progeny of said cross. The broadly recited "flowering response " to "various photoperiods", is interpreted to include any plant differing in any flowering response under any condition of any one photoperiod. Claims 2-4 are broadly drawn to methods where the differentiation of flowering responses occurs within plants in which floral vernalization and floral initiation requires a specific photoperiod or combination of photoperiod treatments. Claims 5-7 are broadly drawn to methods wherein the starting plants exhibit differences within or across stages of development of a female gametophyte. Claim 12 is broadly drawn to a method of making a diplosporic gametophyte-derived hybrid apomictic plant, or an aposporic or polyembryonic non-gametophyte-derived hybrid apomictic plant. Claim 16 is drawn to plants made by an unspecified number of crosses with an unspecified number of parentals of unspecified genotypes to make an apomictic hybrid, recovering seed from the apomictic hybrid maternal plant,

unspecifically produced by selfing or crossing with an unspecified plant, and selecting said hybrid lines for any trait.

Hovin et al (1976. Crop Sci. 16 :635-638) and Purnhauser et al (1993. Cereal Res. Comm. 21 (2-3):175-179) teach that the growth and selection of plants under environmental conditions of a fixed photoperiod is unpredictable in the making of apomicts by a breeding process, and may require the development of genotypic specific tools. Hovin et al teach for example in Table 1; and on page 636, column 2, lines 27-34, that in a 1967 planting, a KB6 clone Fyling cultivar from Sweden, and a KB7 clone PI274646 accession from Sweden failed to flower because the Alabama and Kentucky sites at which they were grown failed to initiate flower formation because they lacked the low enough temperatures that were required for flower vernalization for these genotypes. Furthermore, Hovin et al teach for example in the Abstract on page 635; and Tables 2 and 3 on page 637, that under the same condition of photoperiod, that apomictic seed set for Kentucky Bluegrass clones varied significantly, when grown in different years at the same location, or at different locations in the same year, under the same photoperiod. Hovin et al teach for example in Table 2 on page 637 that New Hampshire and Vermont locations in which Kentucky bluegrass was grown had the same photoperiod of 15.5 hours of daylength, but differed in average daily temperatures. Hovin et al teach for example in Tables 2 and 3 on page 637, that when these New Hampshire and Vermont produced seed were grown at Beltsville, MD, which had a photoperiod of 14.5 hours and a different average daily temperature, that 8.5% (21/243) of the plants of the New Hampshire produced seed were deathly weak or aberrant; and that 5.6% (4/72) of the plants of the Vermont produced seed were deathly weak or aberrant . Hovin et al teach for example in Tables 2 and 3 on page 637, that when these New Hampshire and Vermont produced seed were grown at Rock Springs, PA (which had a photoperiod between 14.5 and 15.5 hours), for two successive seasons, that 8.5% (27/320) and 4.5% (14/320)of the plants grown from New Hampshire selected seed were deathly weak or aberrant; and that 2.1% (5/238) and 1.7% (8/238) of the plants grown from Vermont selected seed were deathly weak or aberrant. Hovin et al teach for example in Table 1 on page and Table 4 on page 638, that two Kentucky Bluegrass cultivars of Maryland origin, KB2 and KB2, grown and selected for in Maryland; exhibited 0.9 % versus 10.8% aberrant and weak plants.

Kenny et al (1996. The American Midland Naturalist 136(1):1-13) and Purnhauser et al teach that the determination of broadly claimed "flowering response" to any one single photoperiod, makes a plant breeding process for apomixis unpredictable. Kenny et al teach for example on page 3, lines 9-22;on page 4, line 9 to page 9, line 21; page 3, lines 9-15; in Tables 1-5 on pages 4-7; and in Figures 1-4 on pages 4-10, the obtaining of a variety of wild accessions of *Erigeron* species, and the evaluation of their floral responses of the time to bolting and number of initiated and formed inflorescences on a raceme, in response to growing said species under conditions of the same photoperiod but different intensity of light, and how these traits correlated with the expression of a trait of apomictic or sexual reproduction. Kenny et al teach for example in the Abstract on page 1, that the effect of light intensity, although altering the response to bolting and the number of inflorescences on the apomictic versus sexually reproducing plants, was insignificant in the expression of an apomictic or sexual reproduction trait. Purnhauser et al teach for example in the Abstract on page 175; and on page 175, lines 1-14, that because non-synchronously flowering plants grown under the same photoperiod may have differing genotypes whose differentiated responses to photoperiod result in different flowering dates, some means of environmental manipulation in addition to photoperiod must be required in order to successfully cross said plants in a breeding process. Purnhauser et al teach for example on page 175, line 8 to page 176, line 7; and page 176, line 11 to page 177, line 46, that no one particular treatment may suffice to accomplish said environmental manipulation to synchronize flowering dates, and that specific regimes are required to be identified, evaluated, and developed , in relation to each genotypic combination utilized for a desired breeding process.

Bates et al (1974. Proceedings of World-wide maize improvement in the 70's and the role of CIMMT, April 22-26 El Batan, Mexico. 7 pp. CIMMT) and Garcia et al (2000. Maize Genet. Coop. Newsletter 74:40-41) teach that barriers to sexual hybridization for a group of species of related groups of species are unpredictable, and that genotype-specific methods are required to overcome barriers to sexual hybridization. Bates et al teach for example on page 5-1B, line 1 to page 5-2B, line 5, that *Tripsacum* and *Zea* are related groups of species, but that sexual barriers to wide hybridizations between *Zea* spp. and *Tripsacum* spp are genotype specific, and include barriers such as hybrid necrosis and pollen cross-incompatibility. Garcia et al teach for example on page 41 that *Tripsacum* species exhibit a diplosporic gametophyte-altering form of apomixis,

similar to the type of apomixis exhibited by *Antennaria* species. Garcia et al teach for example on page 41, that crossing of *Zea mays* inbred line 407B with an accession of *Tripsacum dactyloides* produced hybrid embryos which required embryo rescue *in vitro* on defined tissue culture media, specifically developed for the process of embryo rescue of maize, to prevent the death of the interspecific embryo, by hybrid necrosis on the maternal plant .

De Wet et al (1970. Caryologia 23 :183-87) teach that breeding for apomixis by sexual hybridization with a group of species of related groups of species is unpredictable, because resulting plants may be genetically unstable. De Wet teach for example in the Abstract on page 183; in Table 1 on page 184; and on page 184, line 1 to page 186, line 17, that when a *Zea mays* cultivar is crossed with a *T. dactyloides* accession of 2N=72 chromosomes, that F1 hybrid progeny seed may be produced, but that the F1 hybrid progeny are: all male sterile; all have 2N=46 chromosomes; and are all female fertile and reproduce by sexual reproduction in crosses with *Zea mays*, as determined by the expression of a kernel color gene transferred from a *Zea mays* tester line comprising said kernel color gene. De Wet et al teach for example in Table 1 on page 184; and on page 184, line 1 to page 186, line 17, that BC1 progeny were genetically unstable in successive backcrosses with *Zea mays* to make BC2 and BC2 plant generations, producing progeny plants in the BC2 and BC3 generation with 2N=56, 54, or 50 chromosome genotypes from a 2N=46 chromosome genotype. De Wet et al teach for example in Table 1 on page 184; and on page 184, line 1 to page 186, line 17, that whenever any of the generated 2N=56 chromosome genotype maternal parents were backcrossed, the progeny were always, of a 2N=38 chromosome genotype, indicating that the maternal 2N=56 chromosome tripsaca/maize interspecific hybrids developed normal megasporogenesis and reproduced sexually, rather than apomictically. De Wet et al teach for example in Table 1 on page 184; and on page 184, line 1 to page 186, line 17, that when 2N=46 chromosome maternal parents were successively backcrossed, by the BC3 generation, 80.25% (65/81) of backcross-generated plants still had a 2N=46 chromosome genotype, while 2/81 or 2.5% (2/81) and 5% (4/81) respectively had a 2N=50 or 2N=54 chromosome genotype, and 14.75% (12/81) of plants had a 2N=56 chromosome genotype.

Hovin et al teach that the use of histological methods for the screening, identification, selection, and obtaining of apomict plants from a breeding method, is unpredictable. Hovin et al

teach for example on page 638, column 2, lines 16-26, that in Kentucky Bluegrass, aposporous apomicts may only be identified very early in floral initiation, at the beginning of megasporogenesis, by the histological staining of densely staining cytoplasm in aposporous cells of the nucellus. Hovin et al teach for example on page 638, column 2, lines 16-26, and that enlargement of embryo sacs occur rapidly, in the same general location as the sexually-derived embryo sacs, and since the sexual and apomictically derived embryo sacs exhibited no distinguishing properties, that apomixis could not be assayed or determined after the early stages of megasporogenesis in Kentucky Bluegrass. Furthermore, Hovin et al teach that in Kentucky Bluegrass clones, as high as 2% of the megaspores from any one clone appeared to lack evidence of nucellar staining activity in histological staining assays, indicating that up to 2% of the seeds appeared to be sexually derived, which may inhibit the ability of one to identify and select an apomictic plant.

Garcia et al and de Wet et al teach that the applicability of chromosome counting and karyotype analysis techniques for the screening, identification, selection, and obtaining of apomictic plants in a breeding method, is unpredictable. Garcia et al and de Wet et al each teach the making of maize/tripsaca intergeneric hybrids with *Zea mays* and *Tripsacum dactyloides* to make 2N=56 karyotyped maternal parents, and together teach that karyotyping is unpredictable for the screening, identification, selection, and obtaining of apomictic plants. Garcia et al teach for example on pages 40-41, that the diploid *Zea mays*, including 407B, has 2N=40 chromosomes; the *T. dactyloides* accession used for crossing has 2N=72 chromosomes; *Zea perennis* has 2N=40 chromosomes, and that *Zea diploperennis* has 2N=20 chromosomes. Garcia et al teach that an interspecific hybrid embryo, designated as ZT56 was recovered by the embryo rescue technique, and developed into a plant. Garcia et al teach on page 41 that the ZT56 plants appeared to be male and female infertile, and failed to produce pollen. Garcia et al teach, that although ZT56 appeared to be both female and male infertile, that hybridization with fertile pollen from the related groups of species of *Zea mays*, *Zea perennis*, and *Zea diploperennis*, each resulted in the production of progeny seed, but that the progeny all shared the same maternal 2N=56 chromosome counts of the maternal ZT56 plant, as well as the same molecular marker profile of isozyme gene expression as ZT56, and that ZT 56 was an apomictic plant which required some form of stimulation by pollination, in order to stimulate apomictic reproduction.

De Wet et al teach for example in Table 1 on page 184; and on page 184, line 1 to page 186, line 17, the making of maize/tripsaca interspecific crossing to make 2N=56 chromosome karyotyped maternal parents, which reproduced sexually rather than apomictically , as discussed above. Furthermore, de Wet et al teach for example in the Abstract on page 183; in Table 1 on page 184; and on page 184, line 1 to page 186, line 17, that if a B or P1 kernel color marker allele comprising *Zea mays* tester line is used to cross the 2N=46 F1 hybrid, that the B or P1 gene is transferred into an F1 hybrid to produce F2 seeds expressing the colored B or P1 phenotype, and that even though the 46 chromosome genotype is maintained in the progeny of successive crosses, that the apparent identical karyotyped assessment was unreliable for the determination of apomictic versus sexual reproduction.

De Wet et al teach that the applicability of a screening step for the selection of apomictic plants, on the basis of distinct maternal morphological types among the progeny of a cross, is unpredictable. De Wet et al teach for example in Table 1 on page 184; and on page 184, line 1 to page 186, line 18, that backcrossing with a *Zea mays* pollen donor, to make a BC1 generation from the F1 interspecific hybrid, resulted in the production primarily of the BC1 progeny having a 2N=46 chromosome genotype, and tripsacoid morphology and plant habit, indistinguishable from the F1 hybrid. De Wet et al teach for example, in Table 1 on page 184; and on page 184, line 1 to page 186, line 18, that progressive BC2 and BC3 generations were also similarly produced by backcrossing with a *Zea mays* line that lacked a kernel color B or P1 marker allele, or comprised said marker alleles. De Wet et al teach for example on page 184, line 1 to page 186, line 17, that a tripsacoid morphology and growth habit identical to the maternal parent, and a 2N=46 chromosome karyotype identical to the maternal parent, occurred in said BC2 and BC3 generation progeny. De Wet et al teach for example on page 184, line 1 to page 186, line 17, that although this phenotype could have been interpreted as indicating reproduction by apomixis, that crossing of the BC2 and BC3 with the *Zea mays* tester lines comprising a B or P1 dominant marker allele for a kernel color trait, resulted in expression of both the kernel color trait and the same tripsacoid growth habit and morphology in the progeny of said cross.

Hanna et al (1987. Crop Sci. 27 :1136-1139), Holm et al (1996. Hereditas 125:77-82), de Wet et al, and Garcia et al teach that in the absence of reliable histological, chromosome counting, and karyotyping technique screening methods for apomicts; in the absence of

molecular, genetic, physiological, or morphological markers specifically developed for a particular combination of plant genotypes; the screening, identification, and obtaining apomicts in a breeding process is unpredictable. Hanna et al teach for example on page 1138, lines 2-44, although aspects such as uniform progeny morphology comparable to a maternal parent, limited genetic variation in an apparent F2 generation, unusually high seed fertility in aneuploids, and abnormalities in embryos and flowers may be indicators of apomixis; that detection of one or more of these indicators of apomixis is unreliable, and should be pursued with more detailed and precise genetic testing, including developing homozygous dominant marker alleles in pollinator plants, and to pollinate suspected homozygous recessive alleles in the suspected apomicts. Hanna et al teach for example on page 1138, column 1, lines 39-47, that given the genotype-specific genetic linkage relationships between genes contributing to a trait of apomixis, genotype specifically-developed genetic or molecular markers may be required in order to effectively screen and breed for apomictic traits. For example, de Wet et al teach on page 186; and Garcia et al teach on page 41, that morphological, physiological, and molecular markers specific for use with analysis of maize/tripsaca hybrids were required to distinguish sexual versus apomictic reproduction in maize/tripsaca interspecific hybrids. For example Holm et al teach in Table 1 on page 78; and on page 77, column 1, line 8 to column 2, line 13, that the apomictic form of reproduction in *Potentilla argentea* is so similar to the sexually reproductive form in its biology in the species, that any single plant of the species could not predictably be identified as to its reproductive form, until molecular markers were specifically developed to differentiate the apomictic and sexual reproductive forms in specific genotypes of *P. argentea,* utilizing four molecular markers that were specifically developed to identify maternal and paternal genotypes.

Hanna et al, Carman et al (1997. Biol. J. Linn. Soc. 61:51-94), and Bashaw et al (1987. Chapter 3: Apomictic grasses. Pp. 40-82, In: Principles of Cultivar Development, Vol. 2: Crop Species. MacMillan Publishing Co., NY) teach; and applicant discloses in the instant specification; that a breeding process to make apomictic plants, wherein the plant genotypes comprise polygenic or quantitative trait loci encoding genes whose expression are required to confers a trait of apomixis, is unpredictable. Hanna et al teach for example on page 1137, lines 42-46 that the number of genes and genetic modifiers involved are largely unknown and make prediction of success for a breeding process for apomixis uncertain. Carman et al teach that for

example on page 56, line 45-51; and on page 62, lines 18-45, that a "genetic completeness" (See page 56) from the result of multiple gene expression appears to be the genetic basis for the phenotypic expression of most forms of apomixis, and that although regulatory genes controlling duplicate developmental pathways may mimic simple inheritance, a reliance on this interpretation in a breeding process for apomicts generally produces inconsistent or unsuccessful results, because the actual genetic factors are actually much more complex (See page 62). For example, Bashaw et al teach that either the effect of polygenic inheritance, genotype–specific epistatic interactions, or incomplete penetrance of one or more alleles, may be required to conferred a trait of apomixis in plants. Bashaw et al teach for example on page 47, lines 9-16, that during intraspecific breeding for weeping lovegrass, in which highly sexual plants were crosses with highly apomictic plants as male parents, that the F1 hybrid progeny could be grouped into phenotypic classes of progeny exhibiting either only sexual reproduction, only apomictic reproduction, or an unstable intermediate expression of apomictic and sexual reproduction.

Dung et al (1998. Theor Appl. Genet. 97:714-720), Kraft et al (2000. Theor. Appl. Genet. 101:323-326), and Eshed et al (1996. Genetics 143:1807-1817) teach that linkage disequilibrium effects, linkage drag, and epistatic effects unpredictably prevent the making of plants comprising a polygenic or QTL encoded trait, and that such effects are unpredictably genotype specific and loci-dependent in nature, and that the traits for flowering response to photoperiods appear to be quantitative traits in flowering plants. Dung et al teach for example in Table 1 on page 717; page 717, column 2, line 57, to page 720, column 1, line 51; on page 717, column 2, lines 5-8; and on page 714, column 1, line 1 to page 715, column 1, line 20, that multiple quantitative trait loci are present in most flowering plants, which contribute to the expression of a trait of flowering response to photoperiod, and while some of these QTL loci appear to genetically function in an additive fashion, others may unpredictably function epistatically in an less-than-additive fashion. Kraft et al teach for example on page 323, column 1, line 7 to line 15 the concept known by those of skill in the art that linkage disequilibrium is created in breeding materials when several lines become fixed for a given set of alleles at a number of different loci, and that very little is typically known about the plant breeding materials, and therefore it is an unpredictable effect in plant breeding. Eshed et al teach for example on page 1815, column 1,

line 1 to page 1816, column 1, line 1, that epistatic genetic interactions from the various genetic components comprising contributions from different genomes may affect quantitative traits in a genetically complex and less than additive fashion, so that the making of a progeny with a quantitative trait by sexual hybridization may not be predictably produced from parentals comprising said quantitative traits.

Furthermore, applicant discloses in the instant specification a variety of aspects and problems leading to the unpredictability of the apomictic breeding process, due to polygenic or quantitative trait locus (QTL) inheritance of genes whose expression confers a trait of an apomictic phenotype, and the confounding interactions of complex genotypes with a variety of unknown environmental factors. For example, on page 8, lines 17 to page 9, line 18; and page 29, line 16 to page 30, line 2; page 34, lines 2-5; and page 35, lines 1-17, applicant discloses that polygenic and QTL inheritance distorts genetic segregation ratios which hinders an analysis of apomixis in all plants, and that specifically identified genotype combinations may not predictably be done in a plant breeding process. For example, on page 9, lines 19, to page 11, line 3, applicant discloses that as of the time of filing of the instant application, tripsaca/maize interspecific apomictic hybrids could not be made that had less than nine *Tripsacum* chromosomes.

Applicants fail to provide any specific guidance as to how to overcome the natural sexual barriers to hybridization for the totality of all of the plant species broadly claimed.

Applicants fail to provide guidance for any specific germplasm parental starting source, in the form of any genotype of any accession or cultivar with the recited characteristics, as broadly claimed. The instant specification is replete with listings of a multitude of species of plants which could theoretically be used, but lacks any single form of guidance as to specifically how particular genotypes of these species, or even how any one of the broadly claimed species, would be utilized for : any particular genotypic evaluation, characterization, or selection in a breeding process, required for both "obtaining" plant starting materials with the plant characteristics as broadly recited; or the screening, characterization, evaluation, and selection of hybrids with the phenotypic characteristics as broadly recited. Applicant fails to provide guidance as to how to overcome epistatic and polygenic effects to make and use the invention as broadly claimed.

Applicant fails to provide guidance for any specific photoperiod treatment or treatments and its use in combination with any specific genotype, accession, or cultivar, or which would encompass the totality of all starting plants required for the making and using of the broadly claimed invention

Applicant fails to provide guidance for how to make and use the method with plants whose floral development requires the interaction of environmental factors other than a photoperiod, such as a photothermal response such as floral vernalization. Applicant fails to provide guidance for, or even disclose a particular photoperiod, which alone may be used to specifically make and use the invention as broadly claimed.

Applicant fails to provide guidance for the screening, evaluation, and selection of hybrid plants for the totality of plants as broadly claimed. Applicant fails to provide guidance for the identification, evaluation, and selection of apomictic plants from mixed populations with sexually reproducing plants, when histological and karyotyping screening methods are incapable of distinguishing the two forms of reproduction. Furthermore, applicants fail to disclose any specific plant genotype with any specific plant phenotypic or genotypic marker, required to make and use the broadly claimed invention.

Given the claim breadth, the unpredictability, and lack of guidance as discussed above, undue experimentation would have been required by one of skill in the art to: identify, evaluate, and develop a multitude of photoperiod regimes specific for the combination of broadly claimed plant genotypes having the broadly claimed characteristics; identify, characterize, evaluate, and obtain a multitude of plants to be utilized as starting material; identify, evaluate, and develop a multitude of techniques which would be required for one to overcome barriers to sexual hybridization; identify, characterize, evaluate, and develop a multitude of selection steps which could be used when histological and karyotyping characterization and selection methods cannot be used for identification and selection of an apomictic plant from a mixed population of sexually reproducing and apomictic progeny plants; identify, characterize, evaluate, and develop a multitude of genotypic-specific genetic, molecular, morphological, physiological, or molecular markers; and perform an unspecified multitude of crosses with an unspecified multitude of plants comprising an unspecified multitude of plant genotypes, to make and /or use the broadly claimed invention.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-9, 11-12, 16, 23, and 34, are rejected under 35 U.S.C. 102(b) as anticipated by Saran et al (1976. J. Cytol. Genet. 11:22-28).

Claims 1-9, 11-12, 16, 23, and 34, are broadly drawn to a method for obtaining apomictic plants from sexual plants comprising the steps of : obtaining two sets of delineated lines selected from a plant species or group of plant species differentiated on the basis of different flowering responses to various photoperiods and by their start times and durations of female developmental stages relative to nongametophytic ovule and ovary tissue; hybridizing said lines; and selecting apomictic lines from the interspecific or intraspecific progeny of said cross. A broadly claimed "flowering response" to a broadly claimed photoperiod of any type is interpreted to include a facultative response of a flower to reproduce apomictically or sexually.

Saran et al teach for example on page 1, lines 1-5, that the expression of a trait of apomictic reproduction in facultative apomictic plants is controlled by the environmental conditions under which they are grown, and that the genus *Dichanthium* comprises a number of facultatively apomictic grass species.

Saran et al teach for example in the abstract on page 22; on page 22, lines 1-12, and lines 19-21, that the manipulation of the environmental condition of photoperiod may affect the expression of facultative apomixis not only in *Dichanthium* species, but also at least in other facultative apomicts such as *Themeda australis*.

Saran et al teach the obtaining of two sexually reproducing delineated plant lines of the same group of species which exhibited varying degrees of apomictic expression, growing at the same latitude and longitude as biotypes, and growing in the wild with the same seasonal photoperiod. Saran et al teach for example on page 22, line 25-27 the obtaining of two wild biotype accessions of *D. intermedium* at the same longitude and latitude , which exhibited

varying degrees of apomictic expression in the field, wherein one accession exhibited the production of primarily apomictically produced progeny seed, and another exhibited the production of primarily sexually produced seed.

Saran et al teach the obtaining of at least two sets of delineated lines from a plant species or group of related plant species that are differentiated by their flowering responses to various photoperiods and by their start times and durations of female developmental stages relative to development of nongametophytic ovule and ovary tissue; hybridizing said delineated lines, recovering seed from the hybridization, sowing said seed, and selecting hybrid lines that contain genetic material such that asynchronous floral development and a trait of apomixis is expressed. Saran et al teach for example on page 23, lines 3-5, and lines 29-40, that acetocarmine squash assays and paraffin-embedding, sectioning, and histological analysis assays were utilized to identify and characterize the nature of the apomictic development of these biotypes, and that early stages of megagametophyte development was identical in the lines, and it was not possible to classify sexual or apomictic embryo sacs, but that the development of supernumery embryo sacs in an ovule at later stages of development indicated the expression of an aposporic apomictic trait in the plants assayed, and that in the sexual lines , only one sexual embryo sac developed in each ovule. Saran et al teach for example on page 22, line 24 to page 23, line 26, the crossing of the two sexually reproducing biotypes of *D. intermedium*, which exhibited varying degrees of apomictic expression when grown with the same seasonal photoperiod, to produce a selected F1 hybrid plant designated as X570, which was vegetatively propagated by cuttings, and whose apomictic expression was assayed by cytological and histological methods when grown under different photoperiod regimes in growth chambers, set at approximately 22 degrees centigrade. Saran et al teach for example in Table 1 and Figure 1 on page 23, line 3 to page 27, line 44, that a 12 hour daylength photoperiod treatment of X750 resulted in 63.4% of the embryo sacs expressing the trait of apomictic reproduction, while a 24 hour daylength photoperiod treatment under the same regime of temperature and humidity resulted in the 21.6 % of the embryo sacs of X750 expressing the trait of apomictic reproduction.

Furthermore, Saran et al teach for example in Table 2, that although the 14 hour photoperiod treatment of X750 resulted in the expression of aposporic embryo sacs in 21.6 % of its embryo sacs, very few of these aposporic embryos developed to completion, and subsequently

produced seed progeny, whereas the 12 hour photoperiod treatment appeared to allow a substantive seed set of apomictic seed progeny.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-9, 11-12, 16-18, 23, and 34, are rejected under 35 U.S.C. 103(a) as obvious over Saran et al in view of Bashaw et al.

Claims 17 and 18 are broadly drawn to a method of combining two or more unspecified genotypes with an unspecified number of crosses, and including two steps of "obtaining" plants, which may or may not be the same plants obtained from the first of the recited "obtaining" steps.

Saran et al teach the starting materials and plant breeding method in *Dichanthium*, as discussed in the 35 U.S.C. 102(b) rejection discussed above.

Saran et al do not teach the combining by sexual crossing of more than two developed plant genotypes, to make new apomictic plants.

Bashaw et al teach for example on page 40, line 1, to page 41, line 30, that various grasses may be bred for the trait of apomixis, including species of *Dichanthium*, and that the availability of numerous ecotypes (e.g. biotypes), including those in the "*Dichanthium* complex" of species and related plant species may be used as good starting materials for a process of breeding for new apomictic plants.

Bashaw et al suggest on page 49, lines 24-38, that breeding for new facultative apomictic plants may require additional crossing of F1 hybrid plants, and may require the crossing with similarly identified and characterized facultative apomicts, to avoid problems that may be caused by inbreeding depression.

It would have been obvious to one of ordinary skill in the art to obtain the plant biotype/ecotype plants taught by Saran et al, the method of apomictic breeding with these biotype ecotype plants taught by Saran et al, and to modify the method of Saran et al as

suggested by Bashaw et al, by obtaining other ecotype/biotype plants for the breeding process, and doing additional crosses with facultative apomictic F1 hybrid plants to make new facultative apomictic plants. The number of new ecotypes required to be obtained and the additional crossing with these newly obtained biotypes/ecotypes from the Delhi area, or some other locale, would be an obvious design choice for one of ordinary skill in the art.

Claims 1-9, 11-12, 16-18, 23, and 34, are rejected under 35 U.S.C. 103(a) as obvious over That et al (1987. Rice Int. Commission Newsletter 42:28-34) in view of Koltunow et al (1995. Plant Physiol. 108:1345-1352).

That et al teach for example on page 33, column 1, line 1 to column 2, line 2; and page 34, column 1, line 9 to column 3, line 15, the breeding of rice for the purpose of developing new hybrid heterotic plants with desirable agronomic properties, which would include male sterility, differences in photoperiod sensitivity responses, and apomictic reproduction.

That et al teach for example on page 33, column 2, line 3 to page 34, column 3, line 12, rice breeding methods involving development with two lines as an F1 hybrid, or a line produced with three developed rice lines.

That et al teach for example on page 34, column 1, lines 9-12 the development of inbred japonica rice parentals with differing flowering responses to photoperiod, comprising expression of different pollen fertility to photoperiod, encoded by a facultative photoperiod-sensitive genic male sterile (PGMS) gene, and the development of hybrids with the PGMS encoded trait.

That et al teach for example on page 34, column 2, line 13 to column 3, line 12, the development of facultative apomictic double haploid parentals for the making of at least two apomictic F1 rice hybrids.

That et al suggest on page 34, column 3, lines 4-12, that additional apomictic plants may be produced with their developed facultative apomictic parentals of apomictic F1 hybrid progeny, by additional crosses, which would include any of their other lines, including PGMS lines, or even other plants, and that further apomictic breeding of rice should include the development of molecular markers which would facilitate the breeding for apomixis in rice.

That et al do not teach the combining by sexual crossing of more than two developed plant genotypes, to make the new heterotic apomictic from photoperiodic responsiveness-different plants.

Koltunow teach for example on page 1345, column 1, line 1 to page 1347, column 1, line 42, the various biological forms in which an apomictic phenotype may be produced, and the use of apomixis as a trait to be selected for in a breeding process using sexual hybridization steps.

Koltunow et al teach for example on page 1347, column 2, lines 45-53, that in facultative apomicts sexual and asexual reproductive processes coexist, and that facultative apomictic expression is caused by the erroneous expression in both developmental position and time, of genes that normally function in initiating cascades of gene actions at different times during the course of sexual events in the ovule.

Koltunow et al teach for example on page 1345, column 1, lines 16-28; on page 1345, line 33 to column 2, line 7; page 1346, column 2, lines 34-57; page 1348, column 1, lines 17-30; the breeding method steps of: obtaining starting material with phenotypic and genotypic properties that take into consideration responses to environmental conditions, including those which affect a flowering response that alters the simultaneous flowering of different plant genotypes to be bred; sexual crossing of obtained plants to produce F1 hybrid plants; the rapid and accurate quantification of apomictic plants to evaluate the allelic differences and any additive and/or epistatic influences of modifier loci which may affect expression of an apomictic trait, and the use of genetic or molecular markers for the facilitation of identification of progeny produced by apomictic rather than sexual reproduction.

Koltunow et al teach for example in Figure 3 on page 1351, and on page 1351, column 1, lines 2-5, that the development and verification of apomictic plants may require additional selection and crossing steps with F1 hybrid plants.

Koltunow et al suggest on page 1351, column 2, line 3 to page 1352, column 1, line 15; and on page 1347, column 1, lines 22-42, that their methods and methods steps should be applied to rice breeding, for the development of new rice apomictic hybrid plants.

It would have been obvious to one of ordinary skill in the art to obtain the rice plant materials developed by That et al, and to combine the method of apomictic breeding and breeding method steps taught by Koltunow et al with the rice genotypes with different

photoperiod-sensitive responses and apomictic properties taught by That et al, as suggested by That et al and Koltunow et al, to make the broadly claimed invention.

No Claim is allowed.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Francis Moonan, whose telephone number is (703) 605-1201. The examiner can normally be reached on Monday through Friday 9:00 AM to 5:00 PM (E.S.T.)

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amy Nelson, can be reached at (703) 306-3218. The fax phone number for this Group is (703) 308-4315. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989).

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 308-0196.

Francis Moonan, Ph. D.
6 May 2002

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PRIMARY EXAMINER
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